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**UNIVERSAL MILITARY SIMULATOR II -
AN ANALYSIS**

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BY

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United States Army

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UNIVERSAL MILITARY SIMULATOR II - AN ANALYSIS

AN INDIVIDUAL STUDY PROJECT

by

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As the power of personal computers has increased, commercially available wargames have become more sophisticated. Some of these models may have value in the U.S. Army War College (USAWC) curriculum. This study examines the Universal Military Simulator II (UMS II), and Universal Military Simulator - Planet Editor (UMS-PE), inexpensive commercially available wargames, to determine the feasibility of incorporating them into the curriculum. The analysis concentrates on advanced course 319cj, "Campaign Planning Using Decision Support Aids," as the most appropriate application for these programs within the curriculum, although they may have value in other programs as well. A brief history of wargaming in the military and the development of the microprocessor are followed by specific development considerations to apply UMS II and UMS-PE to the campaign planning advanced course. Observations and conclusions are provided on the feasibility of implementing the programs into the USAWC curriculum.

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Introduction

In 1992, the U.S. Army War College conducted an advanced course entitled, "Campaign Planning Using Decision Support Aids." The objective of this advanced course was for the students to develop and write a campaign plan to defend Thailand against a theoretical invasion by the Peoples Democratic Alliance of Indochina. The difference between this advanced course and the core curriculum course on campaign planning was that the students taking the advanced course used sophisticated computer models to assist them in developing their campaign plan.

The primary model they used was the RAND Strategy Assessment System (RSAS). The RSAS, which runs on a SUN Microsystems SPARC Station, contains 800,000 + lines of computer code, has cost the U.S. government approximately \$25 million to develop since 1982, and requires specially trained operators.¹

Given the recent advances in computer technology, the 1980s and 1990s will be known as the time when the microprocessor enabled computers to develop at a rate and to a degree previously thought to be impossible. At the center of this unprecedented growth in the electronics industry lies the microcomputer. The vast processing power which was once available only in government research labs is now an everyday tool at home and in the office. Simultaneously, there have been significant gains in the development of software to take advantage of this new computing power.

It appears that present-day microcomputers and inexpensive simulation software could perform the same functions as RSAS. If so, there are many advantages which could be realized, such as: eliminating dedicated operators for RSAS; avoiding annual rental cost for RSAS; extending the availability of the simulation to seminar rooms and to correspondence-course students. The potential of using microcomputer-based models to replace the RSAS, providing more flexibility and at a lower cost, is particularly appealing in light of today's smaller budget.

The purpose of this paper is to analyze a set of commercial, microcomputer based wargames, Universal Military Simulator II (UMS II) and Universal Military Simulator II-Planet Editor (UMS-PE), to determine if it is feasible to use the programs in support of the U.S. Army War College curriculum. The paper will first review the history of wargaming in the military, and then highlight the developments and growth of microcomputers in the last two decades. Next it will describe the RSAS system, the current state-of-the-art simulation system in use at the Army War College. Then, UMS II and UMS-PE will be described, highlighting their formidable capabilities and overall flexibility. The criteria for comparing the RSAS and UMS II will then be developed, followed by a description of the "Operation Allegheny" campaign plan, which was used as the basis to compare the RSAS and UMS II. Next, the actual implementation of the "Operation Allegheny" campaign

plan on both systems will be described, followed finally by specific conclusions.

Wargames and the military:

Wargames are not new to the military professional. They have become increasingly sophisticated in their application to help train soldiers and to identify precise military requirements. In 1988, at the request of the Chairman of The Joint Chiefs of Staff, the Defense Science Board developed a plan to integrate computer technology with training for joint decision makers. They looked at how to improve training, joint war fighting, and operational level wargaming. The results of the research indicated a bright future for significantly increased technology application to military use of computers and wargaming as evidenced in the introduction to the report: "The Task Force believes that the only practical and affordable means by which to improve the capabilities of the decision makers is to use computer-assisted, simulated scenarios as the basis for training."² War College students, tomorrow's future senior leaders, can better prepare themselves for their future responsibilities by gaining experience with modern technology and wargames.

The origin of the first wargame is unknown, but is believed to have had its roots in small stones representing warriors on the "game boards" of dirt floors. The Chinese general and philosopher Sun Tsu is generally credited with developing the first wargame.³ In this game, "Wei Hai,"

Sun Tsu demonstrated his principle that "encirclement was preferable to direct attack, and victory went to the first player who could outflank his enemy."⁴ Students of war could use the game to reinforce their understanding and application of their teachings before going into battle.

In 1664 in the German town of Ulm, Christopher Weikhsman developed "King's Game," an advanced form of chess using military terms. "King's Game" gained popular appeal and was played throughout Europe.⁵ As scaled maps became available and armies began to fight across the lands of Europe after Napoleon's revolution, the Germans included increasingly detailed military tactics, techniques and grand movements into their wargames. The Japanese gave much credit for their win in the 1904-1905 Russo-Japanese War to their experience in playing wargames. After their defeat by the Japanese, the Russians seriously incorporated wargames into their training.⁶

The Japanese relied heavily on wargaming to develop their Pacific Campaigns of World War II. The Japanese surprise attack on Pearl Harbor duplicated the conclusion of an eleven-day wargame held in September 1941 by senior Japanese Naval leaders at the Japanese Naval War College in Tokyo. Assessment of the game results showed that two thirds of the U.S. Fleet would be sunk, but with heavy casualties to the Japanese. Admiral Nagumo, who played himself in the game, argued against exposing Japan's carrier force to this danger, "but was over-ruled by Admiral

Yamamoto-the Commander in Chief of the Navy-and chief umpire of the game."⁷

Japanese gaming for the attack on Midway provides a classic example of how reality may not follow gaming assumptions and outcome. In the game, after launching their aircraft, Japanese carriers were attacked by U.S. land-based aircraft. The simulated damage inflicted nine hits, sinking two carriers. The presiding officer directed that only one carrier would be lost, and even this carrier was put back into the next phase of the game. Similar changes were made in aircraft losses, thus insuring Japanese success in the wargame. During the actual battle of Midway, U.S. carrier-based aircraft, which were not played in the wargame, sunk the two heavy carriers, Kaga and Akagi, as depicted in the wargame, as well as two additional heavy carriers.⁸ The insights and conclusions drawn from the wargame were invalid because of one-sided umpiring, and unexpected U.S. forces arriving to insure a decisive battle.

The U.S. was introduced to wargaming in 1867, when a translation of a German game became available. This was quickly followed by two separate games written independently by two American officers, Major William R. Livermore, who wrote *The American Kriegspiel, A Game for Practicing the Art of War Upon a Topographical Map*, and Lieutenant Charles A.L. Totten, who in 1880 published *Strategos: A Series of American Games of War*.⁹ These games were cumbersome and, thus, not used extensively.

McCarty Little of the Naval War College significantly expanded the popular use of wargames in the late 1890s. He introduced them into the curriculum at the college, and they provided new insights into fleet employment.¹⁰ Through the use of wargames, he helped the Navy:

adopt the military planning process, based on the idea that military principles are best learned by application. It consisted of three parts: the estimate of the situation, the writing of the orders, and the evaluation through gaming or maneuver board exercises... to allow problem resolution based upon intelligent options.¹¹

The Navy used the techniques introduced by McCarty Little and the lessons learned from regular wargaming at the Naval War College throughout the inter-war years to prepare Naval commanders for the sea campaigns of World War II. The Navy continued to incorporate wargaming into training leaders at the Navy War College and expanded its capability in 1958 with the opening of the Navy Electronic Warfare System (NEWS). This \$10 million facility included twenty realistic command centers with simulated radar and communications equipment and lights representing ships, planes, submarines, and missiles. The computer thus became a central part of naval simulations, leaving empty the large rooms where wargames were once played with simple replicas of ships and planes.¹²

Army wargaming has been equally rich in its diversity of models and focus, although more difficult to structure

than navy warfare. Army use of wargaming in the late 1930s and 1940s was centered on training and education rather than for planning or analysis.¹³ After WW II, interest in wargaming was primarily exhibited by retired officers, followed in the 1950s and 1960s by a concentration on the cold war realities of nuclear weapons. Increased interest in wargaming in the 1970s and 1980s brought the use of unit level wargames into widespread use. Staff training models normally required a team to create a scenario and to write an event list to drive the players' actions and to support the exercise objectives. Although manpower intensive and time consuming, these exercises provided a war fighting and training focus for leaders without requiring extensive field maneuvers.

At the Army War College in the late 1970s, Colonel Ray Macedonia was actively computerizing hobby board games. The Army Chief of Staff at that time, General Meyer, stated that, "he wanted to improve contingency planning in the Army and the military,"¹⁴ and directed the development of a model by the Army War College to accomplish this formidable task. The result was the McClintic Theater Model (MTM), which became a standard model used at the Army Concepts Analysis Agency and, also, by Readiness Command. As a theater model for command and control systems initially, the model expanded to include additional capabilities in the medical, procurement and maintenance areas. The basic concepts of

the MTM model evolved into the current Joint Theater-Level Simulation (JTLS).¹⁵

Today, modern computers and sophisticated software are integral to military planning and are directly applied to the wargaming process pioneered by McCarty Little. Computer simulations are used today to provide hands-on-training to leaders throughout the Army at the National Training Center (NTC); with the Battle Command Training Program (BCTP); in the Army War College's Curriculum for Course 4, "Implementing National Military Strategy;" the "Capstone Exercise," and in numerous advanced courses.

The development of the microprocessor and the subsequent phenomenal expansion of high technology systems used throughout the military have increased the complexity of modern combat far beyond what our predecessors would have thought possible. High-powered weapons and the quick decisions required for their employment demand that leaders be thoroughly trained. The computer is the basis for new weapons, sensors and communications systems. But it is also an important tool to help train commanders before they arrive on the battlefield. Admiral Thomas B. Hayward, USN (Ret.), aptly sums up the overriding need for wargaming; "Wargaming, in terms of extensive employment of tactical simulators, is no longer a luxury. It is an essential element of the combat training team."¹⁶

The good news for the military is that increasingly powerful computers are faster, smaller and cheaper than ever

before, thus making it possible for training to be conducted on a microcomputer costing around \$2000. Although still needed for large-scale exercises and extensive simulations, mainframe computers, mini-computers, and complex software suites requiring expensive support staffs no longer make up the entire infrastructure for wargaming. This allows for decentralized training and maximizes possibilities for hands-on training of leaders at military schools as well as in troop units. Declining budgets and reduced operational tempo, combined with increasingly sophisticated combat systems, demand the fullest use of computers in wargames and simulations.

Coming of the PC

The small, powerful computers in widespread use today throughout the U.S. were not always so powerful, small, or available. The past four decades have engulfed the world in a revolution, "a technological revolution, which is bringing dramatic changes in the way we live and work-and maybe even think."¹⁷

In 1946, the Electronic Numerical Integrator and Calculator (ENIAC) began operation at the University of Pennsylvania. As the first general purpose computer, the ENIAC was capable of thousands of calculations per minute and used in the development of military weapons. This computer weighed 30 tons, required industrial cooling fans to dissipate the heat it generated and took up the space of

a small auditorium. Primarily relying on vacuum tubes and transistors, the ENIAC had a failure rate of once every seven minutes and cost two million dollars at today's prices.¹⁸

Advances in memory development allowed significant gains by 1955 when, at the Massachusetts Institute of Technology, the Whirlwind and UNIVAC 1 computers were completed. The UNIVAC 1 weighed more than five tons, with the central processing unit measuring 8 feet by 15 feet, and performed a calculation in 0.5 milliseconds (2000 calculations per second).¹⁹

The big breakthrough for computer development came in 1960, when transistors were placed on circuit boards made of thin sheets of silicon and used in processors. This enabled the processor size to be significantly smaller and allowed the production of standardized modules, thus making mass production and a lower unit cost possible. Computer architecture and microprocessor designs improved throughout the 1960s and early 1970s, with increasingly more powerful computers being produced. It was in November 1971 that the Intel Company released its first commercial chip, the 4004 microprocessor, which offered the potential of a computer on a chip. By 1972 the 8080 microprocessor chip was produced and ran at a clock speed of 1 MHz (1 million cycles per second). Its initial price of \$36 fell to around \$2.50 per chip by 1980.²⁰

Once the commercial potential of microprocessors was realized, competition among manufacturers pushed chip design while improved materials enabled clock speeds to achieve 2.5 MHz by 1975 and 8 MHz by 1975. Today's microprocessors are pushing 66 MHz. Along with increased speed of the "computer engine," the data paths for internal and external addressing of information leaped from four to 32 bits. This means that the possible number of memory addresses has increased from 16 to over 4.2 billion. Additional improvements in memory management, data storage, microcode and reduced instruction sets have made the throughput of computers even higher.

The advances made are particularly significant when you consider that today you can buy a low-end \$200 CPU board for a home computer that has more computing power than the 1971 4004 chip, and as much power as the first ENIAC which cost \$1 million! Moreover, "It is twenty times faster, has a larger memory, is thousands of times more reliable, consumes the power of a light bulb rather than a locomotive, occupies 1/30,000 the volume and costs 1/10,000 as much."²¹ The microcomputers today are significantly more powerful than the one used in this comparison, and there is no near-term limit to continued progress. Microprocessors that operate at one trillion operations per second could be available within five years.²²

On top of this power, the prices keep getting cheaper. The 1988 Defense Science Board stated that, "double the computation power can be purchased for the same price every

two years"²³ Continued improvements on an already capable base of microcomputers provides the processing power for a promising future of wargame applications.

U.S. Army War College Curriculum and Facilities

Since its dedication by Elihu Root on 21 February 1903, the U.S. Army War College (USAWC) has ensured that its graduates have been able to help "preserve peace by their intelligent and adequate preparation to repel aggression."²⁴ While much of the "how-to" has changed over the past ninety years, the process of developing the nation's leaders has continued uninterrupted. Incorporating an inexpensive off-the-shelf microcomputer-based wargame into the curriculum's arsenal of tools for the professional military leader, if warranted, supports the goal of ensuring the college remains abreast of modernization, while at the same time saving money.

The War College's "central academic focus of understanding the demands of leadership at the strategic level...and linkages to geo-political factors...and planning and conduct of theater-level warfare"²⁵ provides the main emphasis of study. The broad scope of this focus calls for a diverse and highly flexible course of study. The national security and strategic framework set forth in Course 2 of the USAWC Curriculum includes the influences of national policies, economic power, diplomacy and historical examples.²⁶ Joint and Combined Warfare and Campaign

planning are presented in Course 4 of the USAWC curriculum and focus on achieving national objectives through a theater campaign... The campaign plan translates national military strategy into a theater strategy for military action. An exercise which combines the planning and conduct of a theater campaign, incorporating national political and economic considerations completes Course 4. The difference between the campaign planning advanced course and the core curriculum campaign planning course was that the students taking the advanced course used sophisticated computer models to assist them in the plan development.

The Center For Strategic Leadership (CSL) provides wargaming support to the USAWC. The models they use include the RAND Strategy Assessment System (RSAS), the Theater Analysis Model (TAM), the Tactical Warfare (TACWAR) Model, and the Rapid Deployment Exercise (RADEX) Model. The models, which support both faculty and students, address a wide range of capabilities: global conflict, regional warfare, strategic mobility, tactical allocation and employment of forces at differing resolution.²⁷

Computer hardware at USAWC is divided into two areas. The Land Systems Laboratory of the CSL has VAX 8810 and MicroVAX 2000 minicomputers, SUN SPARC stations using UNIX, 80386 and 80486 microprocessor-based computers using MSDOS or Windows, and several Apple Macintoshes.²⁸ Additional IBM compatible computers are located in each of the student

seminar rooms, and portable computers are available for issue to students throughout the year.

History and Description of The RSAS

The RAND Strategy Assessment System (RSAS) is a modern, state-of-the-art tool used by the Army War College to support numerous courses and exercises on campaign planning. The RSAS is essentially a collection of software modules, approximately 800,000 lines of computer code written in the C programming language and the RAND-ABEL language. It is designed to run on SUN SPARC stations, with a minimum of 500 MB disk storage.

In 1979, the RAND Corporation established the RAND Strategy Assessment Center (RSAC) to work on a Pentagon contract to "develop a new analytical methodology for force designers, operations planners, and assessors of the U.S.-Soviet strategic balance."²⁹ The model was designed to use wargaming in the analysis of complex scenarios which could include parameters such as political decisions, and force levels across the entire continuum of war. The continued improvement of the model over the years has added numerous capabilities resulting in increasingly complex software modules. RSAC transitioned to the Office of Net Assessment, where the demonstration model was upgraded to "operational model to prototype users," and renamed RSAS.³⁰

The RSAS is based on four major principles to make wargaming more efficient and analytical. The first is its

use of artificial intelligence (AI) modules to act as humans in decision-making situations, thus allowing humans to play against an opponent acting under a set of rule-based decision criteria. This enables the analyst to include known characteristics of the enemy force in the simulation. The third principle is to use campaign analysis as the vehicle for interaction between the players and AI modules. The final RSAS principle is that interactive force models are built in order to play the game, and their interaction provides the results of the human and software-based decisions.³¹

RSAS is a powerful, full-bodied simulation which provides an essential tool for studying warfare. The broad range of capabilities of the RSAS allow simulation of national level decisions and decisions of a battlefield commander alike. The RSAS contains multiple databases and terrain information which allow development of world-wide scenarios. The databases contain complete lists of military units and their characteristics of combat based upon realistic data. These data provide the planner ready-made forces to choose from for inclusion in a particular scenario.³²

Political relationships between countries selected for a scenario are initially defined by the operator and can be changed at will. Possible relationships include: enemy, rival, neutral, minimalally, ally, strongly, and maximalally. Additionally, basing rights can be assigned

for air, ground and sea forces for each country. The impact of supplies can be played in the RSAS, but is not always implemented.³³

The RSAS operator uses a "control plan" to modify scenario parameters. Through the control plan the operator can issue orders to units and schedule actions based on either time or events.³⁴

Analytic warplans have been developed and are stored in a library database for use in scenarios. The prepared warplans provide the planner a basic logic plan, broken into phases for execution based upon key events. This shortens scenario development time and can be modified by the analyst through the control plan. Numerous methods are provided to tailor forces, logic, command hierarchy and unit movement.³⁵

Geographic data can be defined using a series of tables describing points, terrain and axes. The "Overlay Tool" is used to draw the lines of communication on the maps. The scenario developer can create essentially any location or route on the map for later transit by units. This allows virtually unlimited flexibility to the scenario designer.

This brief review of the RSAS's capabilities does not provide a full description of its many complex capabilities. Two major points are important to keep in mind for the purposes of this analysis. First is that the use of the RSAS requires a trained operator who is familiar with the translation of order of battle, air allocation, logistics and supply assumptions and who knows the entire litany of

military jargon and requirements. Secondly, as the planner you must focus on the campaign plan and determine what decisions and questions are key and which you can influence. The RSAS is powerful, flexible, complicated, fast, and provides a multitude of feedback to the planner for identifying the critical junctures of the campaign. The RSAS was designed for analysis, and through its evolution, has been steadily improved to its present state-of-the-art position.

History and Description of UMS II

The Universal Military Simulator II (UMS II) and Universal Military Simulator II-Planet Editor (UMS-PE) are commercial microcomputer wargames developed by Intergalactic Development, Inc., of Davenport, Iowa. These programs represent the efforts and skill of talented designers and programmers and offer wargaming enthusiasts and wargaming professionals a robust product for studying the conduct of war. Although the programs are not validated in a technical sense, their parameters are similar to those of the RSAS. The hardware requirements to run these programs are minimal, and because of a desire to make the programs available to the widest possible audience, they run on different machines with the following minimum specifications:³⁶

IBM/Tandy & Compatibles: 512 KB RAM; EGA Monitor with 256 KB video.

Macintosh: 512 K RAM; 1MB RAM for video.

Atari ST: Atari 520, 1040, Mega2, and Mega4 computers.
Commodore Amiga: Amiga 1000, 2000, 2500, and 3000, all
with 1MB RAM.
Apple IIGS: 1 MB RAM.

UMS II and UMS-PE have different purposes. UMS-PE is used to create a scenario: to include all terrain, weather, vegetation, roads, cities, countries, armies, and unit types. It incorporates political alignments, political power, economic power, national will, and a host of other features into the scenario. UMS II takes the developed scenario and allows the player to position and issue orders to units, and modify the impacts of leadership, morale, unit-on-unit combat as well as other variables.³⁷

UMS-PE:

The manual which accompanies the UMS-PE program contains a good methodology for creating a scenario.³⁸ This methodology will be described in this section. Creation of a computer model of some portion of the world, in reasonable detail, is not a trivial matter. Only through the modern tools of the microcomputer and the skill of talented designers and programmers is such a capability even possible. UMS-PE comes with two ready-made scenarios: the Pacific War of WW II and Vietnam.³⁹ These scenarios are historically based and can be used in UMS II, or modified in UMS-PE.

To begin developing a scenario, you must define the land and water features of the theater. A file called

Earth.Dat, a basic representation of the earth, is included with the program. The land and oceans are true depictions of the earth and are accurate to the two degree level of resolution for latitudes and longitudes. You have the capability to stay at the macro level (two degrees) or to "zoom" in through the four available levels of resolution: two degrees, one degree, 30 minutes and six minutes.⁴⁰ Each level is used successively to add detail to the scenario. In order to minimize disk storage and memory requirements, the program saves its files in a compressed format. The practical impact of this for the developer is that the work must be fully completed at a higher level of resolution before going to a lower resolution. For example, assume a road and highway were created at the six minute level. If, subsequently the designer goes to the one degree level to add terrain modifications, the work at the six minute level would be lost. There is no way to recover from this error after it happens.⁴¹ Frequent file back-ups are required to minimize the work lost if this ever occurs.

At the two degree level, terrain types such as grassland, rough, mountain, and jungle are defined. This level also allows defining elevations such as lowlands, highlands, alpine, etc., for the land and seas. Climate factors are entered only at this resolution.

The one degree resolution is used to refine the terrain and elevation defined at the two degree resolution. The nations involved in the scenario are also created and

assigned a "National Will" value between 1 and 99, which represents the nation's readiness to fight.⁴² It is an arbitrary assignment at this point, but it reflects initial strength of support for military and diplomatic operations.

The next step is to create provinces. These can represent states, districts or any other political divisions of the chosen nations. The main use of the provinces is to define strength in production and recruitment potential, to define their technology level, and to have a capital for enemy strategic targeting.⁴³

The final step at the 1 degree resolution is to affiliate the provinces with their countries and to physically draw the borders and entire mass of each province on the map. This process is straightforward and uncomplicated.

The 30 minute resolution provides the designer the opportunity to refine terrain and elevation as well as provincial boundaries. Full use should be made of cleaning up details at this level, for it becomes much more tedious when multiple map screens must be changed in order to get the same effect at the six minute resolution level.

The six minute level, which is the lowest level of resolution, is where the majority of the detailed effort is required. At this point in the process, the player sees only a map showing terrain types and elevation, along with province borders. The addition of cities and ports brings some sense of balance and life to the scene. The "Special

Square Information Tool" is used to designate the location of all major cities and ports for the entire scenario.⁴⁴ Port capacity is defined, which establishes the basis for use of ports in later deployment and replenishment of units. Also defined at this time are initial fortification levels of cities and level of effort in terms of resource costs and minimum time to build new defensive sites. Such data is especially critical if a scenario defined a city as a "center of gravity," and it could not be reinforced. A situation such as that could set the course for an entire campaign and hasten the final defeat of its defenders. In any scenario at least one city for each nation must be designated as the capital, and a provincial capital is designated for each province.⁴⁵

The final step in developing terrain definition is defining the transportation system. The "Draw Path Tool" is used to draw all rivers, canals, trails, paths, roads, railroads, etc., used for movement across the terrain. Roads, railroads and canals can be defined by era; they can be very rough as in the Stone Age, or very modern as in the Space Age.⁴⁶ Location and capacity of these routes will influence how fast units will be able to transit them.

After designing the theater terrain, you assign dates for the starting and ending day of the scenario and the conditions for victory in terms of national strength and time. The strength ratios of the opponents must be high enough to ensure the war does not end immediately, yet not

too high for neither of the belligerents to gain enough for victory.

Military unit icons are used to define armed forces units. The designer can use a separate Armed Forces Editor, a part of UMS-PE, to depict "type units." A total of 40 different icons can be designed.⁴ They will be used later to graphically identify the units assigned to each of the belligerents. The creation of the icons is not difficult and proceeds fairly rapidly. An example of icons in the icon definition program is shown below:

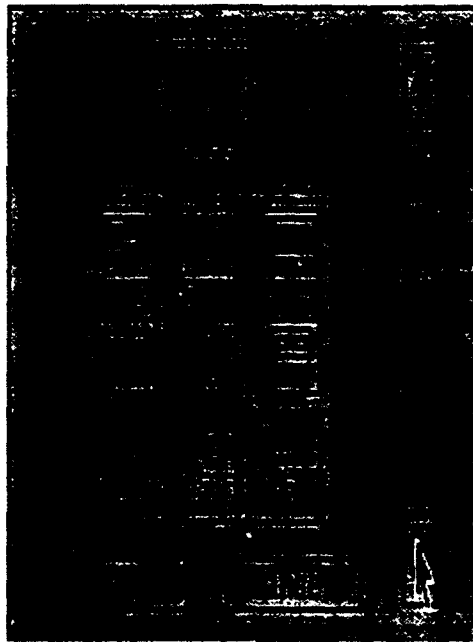


Figure 1. Sample Icons

At this point the icons created with the Armed Forces Editor are aligned with each of the nations. Icons

representing supplies are available for any force occupying the same game square.⁴⁸

The next step is to define the characteristics of each unit type. This is a very time consuming portion of the scenario development. Numerous characteristics of units make them unique and each are important for proper unit definition. Movement, combat strength and effects, logistics, transport and basing are defined for each unit.⁴⁹ The following diagram represents the choices available when first defining a root unit type:

US Unit Type Name: Allied Inf Div

Root Type:

☒ Ground ☐ Air ☐ Orbital
☐ Sea ☐ Missile ☐ Supply

Max strength 35

Min Tech level Age Space Age

Min Tech level Era World War III

Type Characteristics

Movement... Logistics... Basing...
Combat... Transport...

Done

Figure 2. Unit Definition.

The specific movement characteristics of a unit indicates how fast it moves across each type of the terrain. Combat characteristics allow the designer to specify the relative fighting strength of each unit type in both

"attack" and "defend" postures. This allows the light infantry unit with anti-armor weapons confronting an armored force to be given credit for assuming a good defense.

The example above defines an Allied Infantry Division which is a ground type unit. Technology level can range from "Stone Age" to "Space Age" with additional choices within each Age. Unit strengths can vary from 1 to 99.⁵⁰ It is important to remember that the maximum strengths, by unit type, are being assigned. Later when specific units are created and put into an order of battle, they are assigned their initial strengths.

Once all unit types are defined, specific units are created for the scenario. This process is fairly easy; it consists of selecting an icon for each unit and moving it to a single "Order of Battle Table" for each army. The armies are created in a top-down fashion with a four-level hierarchy, the last level representing the fighting units. Once the units are fully created and placed, the development portion using UMS-PE is complete. The files defining the scenario, consisting of terrain and units, are then loaded into the UMS II program for further definition.

UMS II:

The previous section described the major scenario development. Once the scenario is created, UMS II is the program which is used to actually run the simulation. UMS II also allows additional parameters--political, economic,

The Master Control Panel (MCP) enables the planner to modify a myriad of variables to produce a scenario as realistic as possible.⁵² The chart below shows the MCP screen for the user to define ground attrition:

[illegible]

25

Ground casualties are a function of the engaged units relative strengths, experience, leadership, morale, and supplies,--and the combat formation of each unit. All the factors can be set by the user and are used by the model in a "battle equation" to determine combat outcomes.⁵³ The five categories of relative advantage and the seven possible ground combat formations are shown below:

<u>Advantage</u>	<u>Ground Military Formation</u>
80%	Screen
60-79%	Defend
40-59%	Hold
20-39%	March
< 20 %	Forced March
	Attack
	Assault

Figure 4. Casualty Factors

This allows the user to assess higher casualties to a unit engaged during a forced march when security is lowered in the interest of speed than one on the march or in a holding position. Also the type of formation is directly related to the rate of supply consumption. A unit in the attack would be assessed a higher use of precious supplies, fuel and ammunition, than one in a screening posture. These choices can be made for all ground, sea and air units.

The user can modify the "battle equation" to reflect that dimension of the battle which he believes to carry the

most weight. The four variables he may select from are morale, leadership, experience and random. A percentage weight may be assigned to each of these for their expected impact on the outcome of a battle. For example, if experience was deemed to be the most critical, then it may be given a 60% weight with the remainder divided between the other variables. If the element of randomness was not wanted, then the random variable could be set to zero.⁵⁴ These capabilities allow the planner, just like a ground commander, to assess and weigh factors they deem most likely to influence the battle.

Earlier in UMS-PE, the armed forces available were defined and positioned. For air wings, however, the aircraft must be based in UMS II. The user can place air units at any airfield which has sufficient capacity. Naval and Marine aircraft may be based at airfields or on a carrier.⁵⁵

Army units may deploy from home station to the theater of operations aboard Navy ships and by transport aircraft. Departure and arrival airfields and ports were created using UMS-PE. The player may order units to move to a departure airfield and await transportation to the theater of war. The units will be transported to the theater of war, in phases if needed, when sufficient transportation capability is available.⁵⁶ The model requires the user to consider the major logistical aspects of deployment and sustainment,

accurately reflecting real-world feasibility planning considerations.

UMS II includes the ability to define seven characteristics of each nation, as shown in Figure 5.⁵⁷

Thailand			
MULTIPLE ENEMIES		SINGLE ENEMY	
[Slider]		[Slider]	
DIPLOMACY		OBJECTIVES	
AGGRESSIVE		PASSIVE	
[Slider]		[Slider]	
BEHAVIOR		DIVISION OF FORCES	
SEA		LAND	
[Slider]		[Slider]	
CAMPAIGNS		PRODUCTION GOALS	
OFFENSIVE		DEFENSIVE	
[Slider]		[Slider]	
STRATEGIC POSTURE		Continue	

Figure 5. National Characteristics

The user can set these characteristics to reflect how he wants the artificial intelligence routines to respond when the model is run. The computer can play any and/or all the nations in the scenario as a "computer general." For example, when Strategic Posture is set to "offensive," the general will attack his enemies without regard to borders, whereas one with a "defensive" leaning would be more cautious and tend to stay within his own territories. A setting between the two extremes would allow the general to

act in both realms, but not as totally as at either extreme.⁵⁸

Once the Master Control Panel and national characteristics are set for all countries, battle may begin. The game may be played in many ways; with multiple players, with one player for all/both sides, or with the computer playing one or both sides. The play can either be in a "Demo" mode, where the computer makes choices and execution continues until game termination, or in a single step manner, allowing decisions to be made and input after each set of orders is executed. Whether in "Demo" or step-by-step mode, the sequence of phases includes setting National Orders for all countries and then executing those orders.⁵⁹ Setting National Orders triggers issuance of specific orders down to the lowest fighting unit. It is here also that decisions to initiate building of fortifications or training armies can be made. During each execution phase, reports are available on all combat results.

The combat, replenishment and orders process continues until one of the victory conditions for strength or supplies is achieved by one of the combatants. UMS II allows the planner wide latitude in setting initial parameters to determine how the scenario will be executed. While not perfect, the program does provide the planner ample opportunity to incorporate critical aspects of military, political, economic and basic tendencies of nations into a sophisticated, microcomputer-based wargame.

MOE for Comparison

Comparison of the RSAS, currently used for campaign planning at the war college, and the UMS II and UMS-PE microcomputer programs centered on criteria considered important for student use in campaign planning. The parameters available to be changed in the scenarios must reflect the planner's choices in strategic and operational levels of war in a joint and combined environment. The scenario development process and the actual execution of the campaign plan were both considered in the comparison. The following is a list of criteria, with a short explanation of each, used to evaluate the programs.

Terrain: Creation of a realistic land form and ocean complex to represent the theater of operations must be possible. The terrain and elevation in any potential area of conflict and scaled distances between all locations are necessary for accurate simulation. The accurate representation and placement of rivers, canals, roads, cities and airfields allow for accurate terrain analysis and unit trafficability planning.

Force Building and Aggregation: Force lists for combatants must reflect actual assigned forces. Then they can be tailored by the planner to examine different organizations for combat. The forces must reflect accurate relative combat power and capabilities commensurate with

their type unit and the terrain where they are located. The level of units which can be portrayed must go from the army group down to battalion and offer the planner the freedom to identify any specially capable units, e.g., special operations forces. This allows the focus to remain on the appropriate level--strategic or operational--instead of requiring the planner to delve into tactical combat activities. The joint nature of battle must be represented, thus giving the player the ability to build and fight ground, sea and air units under a joint command configuration. Accurate placement of units on the ground or aboard ships is essential.

Political Alliances: The campaign planner must be able to consider allied, enemy and neutral countries. The designation of friendly or enemy forces, and incorporation of the friendly forces into a military relationship is required. The ability to change a country's alliance status offers the planner a chance to determine if the change was significant or not.

User Involvement: The ability to modify the scenario before execution and at some point during its execution is crucial. The player must be able to stop the execution and back-up in order to then introduce a different unit mission or unit location to determine if the change significantly impacts a later outcome. Timely feedback to the player during the course of the campaign on troop strengths, major events, and unit status are needed. At game termination,

there must be feedback on results of the campaign. It should include final strength of forces and a final trace of the opposing army's front lines, or some other informative report to the player.

Speed of Execution: The planner must not have to wait for a long period of time to either get results or to make another move. Running without interruption, sixty days of combat should take less than twenty minutes to complete. When run interactively, the model should provide the results of five days of combat in less than five minutes. Interaction with the model builds the planners sense of the campaign by involving him or her in the action. Sluggish response time impacts in two direct ways; first it decreases the attention required of the planner, causing his or her mind to wonder; and secondly it decreases the number of runs which can be examined by the planner in any given time frame.

Computer Opponent: The number of opponents determines the possible ways a simulation can be played. The computer program must be able to play any or all sides in the simulation.

Flexibility: The ease of use and ability to change parameters in the scenario, during development and execution, assist the planner in the planning process by allowing the "what-if" questions to be asked and then rapidly simulated. The shift away from the former static bipolar world with its set assumptions, alignment of forces

and theaters of operations increases the need for flexible modeling of future world situations. The capability to rapidly modify the scenario insures the continued relevance and use of the model.

The above criteria were used to compare the PSAS with UMS II and UMS-PE for campaign planning. The most critical are: accurate terrain and forces, political relationships, speed of execution and replay, and flexibility to modify parameters.

Description of "Operation Allegheny"

The 1992 Advanced Course on "Campaign Planning Using Decision Support Aids" was based upon a fictional scenario in the 1996-1997 time frame. A U.S. led coalition consisting of Thailand, France and Australia deployed to Thailand in an operation dubbed "Operation Allegheny," in order to deter aggression from the Peoples Democratic Alliance of Indochina (PDAI) (a confederation of Vietnam, Laos and Cambodia). The purpose of the course was to develop a campaign plan from deployment through redeployment using computerized decision support tools to help develop, test and evaluate the campaign plan.⁶⁰

An extensive background document covering the 1992-1996 time frame was provided to the students in order to set the strategic political and military scenario. They also were provided a troop list and the JCS Warning Order which contained the following partial situation:

The situation in Thailand is tense as PDAI presents a clear, near-term, military threat to Thailand. Vietnamese forces are partially deployed with the capability of a coordinated offensive against Thailand with Laotian and Kampuchean forces. Of particular concern is the Khorat Plateau area of Eastern Thailand which possesses terrain suitable for mounting quick strike mechanized, airborne, and airmobile offensive operations.⁶

The order of battle for the PDAI and the U.S. Combined Allied Forces Thailand (AFTHAI) Organization were also provided to the planners. "Operation Allegheny" was not only a realistic task for the students to tackle, but also indicative of the challenges facing operational planners assigned to the CINCs in the field. The theater of war campaign plan followed the standard campaign format and included considerations of strategic guidance, NSC implied tasks, friendly and enemy centers of gravity and forces as well as assumptions. The following mission statement was developed:

When directed by PMCC, AFTHAI conducts operations to deter PDAI aggression against Thailand. If deterrence fails, AFTHAI defends Thailand to ensure/restore territorial integrity, destroys PDAI offensive capability, and prepares to conduct follow-on operations as directed.⁶²

The concept of operations was for AFTHAI to conduct the campaign in five phases:

Phase I Deterrence: C-Day to C+89
Phase II Defense: D-Day to D+14
Phase III Counteroffensive: D+12 to D+19

Phase IV Follow-on Opns: D+20 to D+90
Phase V Redeployment: D+91 to D+270⁶³

Phase I included a rapid deployment of allied forces into the theater and to have Thai forces forward deployed to defend along the border. Five main avenues of approach (AAs) into Thailand were identified. Priority of defense was given to protection of those AAs threatening the Khorat Plain. U.S and Thai units were deployed to defensive positions covering all five AAs, and a reserve was established north of the City of Khorat.⁶⁴

Phase II of the operation began when PDAI forces attacked. The plan called for AFTHAI to conduct an aggressive defense using delay from the east to allow a shaped penetration into which the PDAI would commit its second echelon forces. Air superiority was the primary air mission for this phase. Air allocation percentages were provided for the first fourteen days.⁶⁵

Initiation of a counterattack by III(US) Corps into the PDAI flank from the north would initiate Phase III. Destruction of all division size combat units would end Phase III. Follow-on operations would ensure destruction or withdrawal of PDAI forces and re-establishment of the Thai borders. Air operations would target PDAI military capabilities. First (US) Corps and I MEF(+) would be prepared to conduct a ground offensive toward Phnom Penh. At conflict termination redeployment would begin.⁶⁶

The campaign plan included the allocation of air power, combat forces, priorities of fires and logistics for deployment, combat, and redeployment. "Operation Allegheny" required the students to consider political decisions and to integrate all aspects of joint and multinational warfare in developing this detailed campaign plan.

RSAS and "Operation Allegheny"

Two major functions in the development of "Operation Allegheny" warranted the use of computers--deployment and course of action (COA) development. The Rapid Deployment Exercise Model (RADEX) was used for the deployment of air, sea and ground forces into the theater of war. It proved to be a faster and easier-to-use model for conducting the deployment feasibility analysis than did the RSAS. Once the units arrived at their port or base of debarkation in theater, the RSAS database was modified to reflect initial unit locations within the country.

Basic scenario information, such as location of the operation, countries involved, background information and order of battle for each force, was provided to the RSAS operator. Because RSAS already includes a force database, the order of battle and unit assignments were built fairly rapidly. The PDAI combat forces were created from the forces of Vietnam, Laos and Cambodia, all of which were already in the RSAS database. Creating the scenario order of battle and refining airfield and port data required about

one week to complete. The basic terrain database for the theater of operations required some modification and additional detail. These changes required an additional day of the operator's effort. An experienced operator could expect to complete a basic scenario, to include baseline runs to eliminate any bugs in its execution, in around 10 days. A period of approximately four weeks was required to build the scenario so that students could test various COAs.⁶⁷

Once the RSAS operator had input and checked-out the scenario, the next step was to incorporate the specific courses of action developed by the students. Through the control plan, the operator was able to assign missions, base aircraft and units and allocate air to reflect the percentages assigned to each air mission type: Close Air Support, Battlefield Air Interdiction, Defensive Counter-Air, and Escort. Approximately one day was required for the operator to write and run three courses of action in order to develop useful feedback, given to the students at their next class meeting. The purpose of running the three COAs was to provide comparisons rather than analysis of the combat results and to provide the results in the form of force lists, unit locations and the forward line of troops (FLOT).⁶⁸

After analyzing the initial courses of action, a final course of action was developed and the RSAS scenario was adjusted to reflect any changes. The scenario was then run

numerous times to allow the students to observe the action of units, to see the results of air power, and to assess the effectiveness of their plan. Students identified additional modifications and the changes were made to positioning, unit mission, air allocation and numerous other variables, and then re-run to determine the impact.⁶⁹

The RSAS was able to stop and back-up to a period of interest and replay the simulation. One of the great strengths of RSAS was its speed, which allowed multiple iterations to be analyzed by the students in a short period of time. Multiple missions, which can be activated at a certain time or upon the occurrence of a specific event, can be assigned to a unit through the control plan. This allows the RSAS to run for a specified period of time without human intervention. Although not performed very often, a full 60-day combat scenario only takes approximately 10 to 15 minutes to run, to include providing the output of a map of the region, a force list situation report and a FLOT trace. While using the RSAS for the advanced course in the spring of 1992, the CSL operators assisting the students estimated that over 7,000 days of deployment and 20,000 days of combat were modeled, all in about a two-week period.⁷⁰

The RSAS served as a tool to help the students determine their best course of action for "Operation Allegheny." The RSAS's main strengths were its capability to accurately model the theater of war and to build a rough scenario within ten days. The speed of operation allowed

the scenario to be modified and run many times in order to identify those elements in the plan which were most sensitive to change. The ability to ask "what if" questions and to then simulate various possibilities substantially supported the students in their quest for determining the "best" COA.

The RSAS also has some weaknesses. Annual maintenance fees and the requirement for a trained operator add costs to maintaining the system. The need to run the RSAS on SUN SPARC computers limits the possible places where the RSAS can be employed. While there are technical aspects of the RSAS being reviewed for enhancement, the current system already provides the planner a solid tool to assist in developing a campaign plan.

UMS II and UMS-PE -- "Operation Allegheny".

Implementation of "Operation Allegheny" using UMS II and UMS-PE followed basically the same process as when using the RSAS, the difference being that UMS II and UMS-PE had not previously been used for this type of simulation. The basic methodology for scenario development in UMS-PE, as described earlier, was used to produce a scenario representing the Thailand theater of war, to include allied and PDAI forces and countries. Although, like the RSAS, the UMS II programs can be used to deploy forces into the theater of war, this feature was not evaluated in this comparison because the RSAS was not used to deploy any

forces in "Operation Allegheny."⁷¹ UMS-PE and UMS II were used for scenario development and combat simulation.

Scenario development in UMS-PE was both enlightening and frustrating. The program allows the developer to create virtually any situation imaginable. For "Operation Allegheny" every natural and man-made feature extracted from a map study was able to be represented in the scenario. There were no limitations in designing forces, to include their size, capabilities and weapons. Creating forces which represented the allied and PDAI forces accurately was time consuming and fraught with many initial errors and subsequent improvements. The ability for the designer to assign relative advantage between two opposing units based upon the type of terrain they were fighting on allowed realistic and detailed modeling. All units were defined and assigned relative strengths based upon guides provided in the Vietnam scenario which was shipped with the program. The development of unit icons was not difficult, but they would be more useful if they were more detailed and could be displayed at a higher resolution.

Particularly appropriate for the study of campaign planning at the war college was the ability to include national policies, national will, a country's basic behavior and economic might into the campaign equation. Supplies were included in determining combat sustainability and did influence the allocation of transport and resupply of all units. During the trial runs conducted to establish a

baseline, the supply usage and resupply had to be modified in order to continue with the simulation--a realistic factor which is a real-world planning consideration.

The scenario development, for a first-time user of the UMS programs, for "Operation Allegheny" required approximately two months of part-time work. An experienced developer could probably create a first-class product in about four to five weeks. UMS-PE proved to be a powerful, full-featured tool which allowed most aspects of the scenario to be incorporated. However, its ease of use in positioning units, creating order of battle and defining unit combat characteristics could be much improved.

One noticeable limitation was that there is no way to allocate air power. Aircraft were defined by speed and combat power and air units were assigned missions, but there was no way to assign a percentage of the total air available to a specific mission--CAS for example. To compensate for this problem, air force units were assigned missions in a mix to portray desired air mission priorities.

Once the "Operation Allegheny" scenario was created and units were positioned and initial orders issued, UMS II was ready to run. As was expected, the interactive wargame capabilities were impressive. UMS II allowed the player to fight the battle, issue orders and receive feedback on battle results. Unlike the RSAS, UMS II was unable to accept multiple orders that could be executed at a later time based upon reaching a certain time or specific event.

This required the player to intervene continuously and assess the situation, then issue new orders.

As a tool to assist students comparing COAs, UMS II was not a great help for a number of reasons. First, there was no capability to stop and back-up to a point of interest, make a change, and replay. This prohibited one of the most useful functions in COA analysis. Secondly, the speed of operation is too slow to run multiple scenarios in a reasonable time; it took over three hours to simulate 60 days of combat when the program ran under the control of the "computer general." When the player actively issues orders and responds to the enemy actions, the same scenario required over five hours to play. Reducing the effect of supplies, and eliminating all "spot reports" did not significantly shorten the waiting time.

Comparison of Results

As we have seen, the RSAS and UMS II were both able to implement "Operation Allegheny." The criteria identified earlier in the section on "MOE for comparison" will now be used to highlight selected observations of the differences and similarities between the RSAS and UMS II simulations of "Operation Allegheny."

Terrain: RSAS and UMS II/UMS-PE provided a full representation of the terrain used for this campaign without any compromises. The development of the area in UMS-PE required more effort in the beginning to create terrain,

political boundaries and all roads, cities and airfields from scratch. The building tools provided were fairly easy to use and were limited only by the imagination of the designer. The main drawback for UMS-PE in this category was that great care had to be exercised to avoid overwriting previous work done at a lower level of detail. The program included a warning, however, if this was missed or ignored, then the land and sea data could be totally corrupted. Weather could be included and used to assess the impact of rain, monsoons or other conditions which could influence the outcome.

The RSAS came with a well-developed terrain database. Terrain features could be added to show the lowest detail desired or to update some facility. The capability to get the distances between points on the map was a plus. Both models were able to provide all necessary terrain data for "Operation Allegheny." Development using the RSAS was faster, mainly because of its pre-developed geography database. The UMS II terrain file did not provide the same degree of detail. Use of the models to investigate the effect of changing parameters on the COA would favor the RSAS. Whereas, the onetime creation of a campaign plan would not favor either UMS-PE or the RSAS.

Force Building: UMS-PE offered unlimited flexibility to create all units required for the scenario. The chain of command relationship from the highest levels down to the individual fighting unit was easily defined and incorporated

into the total force. While the initial defining of unit characteristics was time consuming when compared to the ready-made RSAS units, the potential exists to build any type or size unit needed. This provides the capability to introduce new units and weapons into future scenarios. UMS-PE provided unlimited capability to assign combat strength to each type of unit created. The RSAS and UMS-PE allowed the user to build coalition forces. The existing force structure in the RSAS shortened scenario development time and provided a complete set of units from which to chose. Stationing the units in the RSAS by using the control plan was easier than initial positioning of units using UMS-PE. This was especially important while developing the alternative COAs. However, both programs provided sufficient capability to portray the units and command structures needed for "Operation Allegheny."

Political Alliances: Each country's individual relationship with all other countries was defined as neutral, friendly or enemy. UMS II provided additional considerations by including political will and its impact on a country's willingness to continue to prosecute the war if it suffered the capture of a capital or severe economic losses. This feature did not influence the outcome of the "Operation Allegheny" campaign, but it provides an added variable for consideration when longer campaigns are simulated.

Computer Opponent: This criteria was met by both models. In "Operation Allegheny" the computer opponent played the PDAI forces and the students played AFTHAI. For campaign planning, this assignment of roles seems to be the most applicable.

Speed of Execution: The RSAS was significantly faster than UMS II in executing the scenarios for "Operation Allegheny." Where the RSAS ran 60 days of combat in ten to fifteen minutes, UMS II took over three hours. Even though campaign planning generally focuses on shorter time segments, the speed difference between the two models, for these shorter time segments, was still significant. The RSAS excelled in providing fast scenario runs, whereas, UMS II did not provide the speed required for fast-paced campaign planning.

User Involvement and Flexibility: Campaign planning requires the active involvement of the planners so that they get a sense of what is happening on the battlefield in order to determine the best concept of operations and course of action. UMS II and the RSAS both achieved the goal of active involvement. The RSAS requires an operator to interact with the model directly, but provides significant feedback to the planner through maps and unit locations based upon multiple runs. The experienced operator can significantly improve the quality of the feedback and help insure that all pertinent factors are adjusted accurately. The RSAS speed of execution previously discussed also

contributes to keeping the planner involved by allowing many "what if" questions to be addressed. The ability to stop a run and back-up to a time of interest to replay it with some modification provided one of the most important tools to the planners of "Operation Allegheny." This capability enabled the planners to determine the most sensitive aspects of the campaign and to then focus their attention on developing options to maximize the outcomes. UMS II was not able to stop a run and back-up for subsequent comparisons. To even start a new run required loading a copy of the original scenario from another disk and then beginning anew. Even this procedure was not satisfactory because of the slow execution speed of UMS II and the inability to capture previous actions in a methodical manner. UMS II did not perform nearly as well as the RSAS in this criteria.

Another measure of flexibility is the availability of the models. UMS II was able to run on multiple, inexpensive microcomputers with virtually no limit on their location. The RSAS on the other hand could only be run on a RISC-based SUN computer and requires a trained operator. The UMS II model certainly holds more potential than the RSAS for any implementation designed to be used by multiple people at different locations at one time. An example of this would be the possible use of UMS II by correspondence course students in their campaign planning development exercise. External support using microcomputer-based products has a high potential for the U.S. Army War College in the future.

Conclusions

UMS-PE and UMS II are not ready to be used in place of the RSAS at the U.S. Army War College. The "Operation Allegheny" campaign scenario was modeled using UMS II and UMS-PE, but in operation the performance of UMS II was not responsive to the timely demands of COA analysis. Although UMS II did provide some capabilities which were not available in the RSAS, there were two main reasons for not recommending UMS-PE and UMS II for use at the USAWC.

The first, and most important, was the inability of the program to provide a replay facility that allows the user to review actions and then to make immediate changes to investigate any different outcomes. This capability was determined to be crucial for any simulation used for campaign planning where the main purpose is for the planners to develop and compare their courses of action. Without this capability in UMS II, the planner was not able to ask "what if" questions and then determine the sensitivity of the campaign results to the modifications examined.

The second reason is speed. The planner needs to run many iterations of the scenario. Fast execution of each run minimizes the time wasted by the user while waiting for results. UMS II does not provide the campaign planner adequate speed to run numerous iterations of a scenario.

The UMS-PE and UMS II combination provides a well-designed product for use in building a scenario and then playing the wargame. However, it does not stand up to the

demands of a campaign analyst, who needs the additional features of speed and back-up to accomplish his demanding tasks.

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53Ibid., 5.8.

54Ibid., 11.8.

55Ibid., 8.3.

56Ibid.

57Ibid., 13.2-13.4.

58Ibid., 13.3.

59Ibid., 2.11.

60Department of The Army, Campaign Planning Using Decision Support Aids-Course 319, Course Syllabus (Carlisle Barracks:U.S. Army War College, 1992), 1.

61Department of the Army, Campaign Planning Using Decision Support Aids-Course 319, JCS Warning Order for Exercise Allegheny (Carlisle Barracks:U.S. Army War College, 1992), 3.

62Department of The Army, Campaign Planning Using Decision Support Aids Course 319, Theater of War Campaign Plan for "Operation Allegheny" (Carlisle Barracks, U.S. Army War College, 1992), 7.

63Ibid., 8.

64Ibid., 9.

65Ibid., 11.

66Ibid., 11-16.

⁶⁷Interview with Bob Chicchi, U.S. Army War College, Carlisle Barracks, Pennsylvania, 10 February 1993.

⁶⁸Ibid.

⁶⁹Ibid.

⁷⁰Col Doug Williams, CPT Kevin McClung, and Bob Chicchi, "RSAS Use At The United States Army War College," RSAS Newsletter Volume 4, Number 3 (August 1992): 13.

⁷¹Interview with Bob Chicchi, U.S. Army War College, Carlisle Barracks, Pennsylvania, 10 February 1993.

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